

# Sheet 4

[5]

ADD # Num, R<sub>1</sub>

↙ immediate

(a)

Suppose your instruction is two word so your operand in 2nd word

1 - PC<sub>out</sub> , MAR<sub>in</sub> , Read, select 4, add, Z<sub>in</sub>

2 - Z<sub>out</sub> , PC<sub>in</sub> , Y<sub>in</sub> , WMfc

3 - MDR<sub>out</sub> , IR<sub>in</sub>

4 - PC<sub>out</sub> , MAR<sub>in</sub> , Read, Select 4, Add, Z<sub>in</sub>

5 - Z<sub>out</sub> , PC<sub>in</sub> , Y<sub>in</sub>

6 - R<sub>out</sub> , Y<sub>in</sub> , WMfc

7 - MDR<sub>out</sub> , Select 4, Add, Z<sub>in</sub>

8 - Z<sub>out</sub> , R<sub>in</sub> , End.

[1]

sec 4

② ADD <sup>← Absolute</sup> num, R<sub>1</sub>

①

⑤ Z<sub>out</sub>, R<sub>in</sub>, Y<sub>in</sub>, WMFC

⑥ MDR<sub>out</sub>, MAR<sub>in</sub>, Read

⑦ R<sub>out</sub>, Y<sub>in</sub>, WMFC

⑧ MDR<sub>out</sub>, select y, Add, Z<sub>in</sub>

⑨ Z<sub>out</sub>, R<sub>in</sub>, End.

ADD <sup>← indirect</sup> (num), R<sub>1</sub>

③

①

⑥ MDR<sub>out</sub>, MAR<sub>in</sub>, Read, WMFC

⑦ MDR<sub>out</sub>, MAR<sub>in</sub>, Read

⑧, 9, 10 → 7, 8, 9

② Sec 9

# a Program for A, B, C

- 1  $\rightarrow$  4
- 5 -  $Z_{out}$ ,  $PC_{in}$ ,  $Y_{in}$  if Imm branch to 1.
- 6 - WMFC
- 7 -  $MDR_{out}$ ,  $MAR_{in}$ , Read, if Abs branch;
- 8 - WMFC
- 9 -  $MDR_{out}$ ,  $MAR_{in}$ , Read.
- 10 -  $7 \rightarrow 9$

[3]

Sec 4



7

$$\frac{28}{42} = 67\%$$

2ns

- 1- \_\_\_\_\_
- 2- \_\_\_\_\_, WMFC memory  $\leftarrow 16ns$   
CPU  $\leftarrow 2ns$
- 3- \_\_\_\_\_ 2ns
- 4- \_\_\_\_\_
- 5- \_\_\_\_\_, WMFC 16ns
- 6- \_\_\_\_\_ 2ns
- 7- \_\_\_\_\_ 2ns

How long does memory take as a percent  
of overall time of CPU instruction execution.

4 sec 9

## Sheet 5

- Single bus CPU

- 1 -  $PC_{out}$ ,  $MAR_{in}$ , Read, select 4, Add,  $\bar{Z}$ ,
- 2 -  $Z_{out}$ ,  $PC_{in}$ ,  $Y_{in}$ , wait
- 3 -  $MDR_{out}$ ,  $IR_{in}$
- 4 - (offset field of  $IR$ )<sub>out</sub>, Add, if  $N=1$  then  $PC_{in}$ , End

Branch  $\rightarrow$

- multibus CPU  $\leftarrow$  نموذج البص

- 1 -  $PC_{out}$ ,  $R=B$ ,  $MAR_{in}$ , Read, Inc PC
- 2 -  $WMPC$
- 3 -  $MDR_{out}$ ,  $R=B$ ,  $IR_{in}$
- 4 -  $PC_{out}$ , (offset field of  $IR$ )<sub>out</sub>,  
Add, if  $N=1$ , then  $PC_{in}$ , End.

5 sec 9